**Historic, archived document**

Do not assume content reflects current scientific knowledge, policies, or practices.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils,
and Agricultural Engineering.

H. T. & S. Office Report No. 194

# RELATIONSHIP BETWEEN THE BRUISING AND DECAY OF APPLES.

By

T. R. Wright, associate pathologist
and
Edwin Smith, senior horticulturist

Division of Fruit and Vegetable Crops and Diseases.

Wenatchee, Washington
September 3, 1948.

# RELATIONSHIP BETWEEN THE BRUISING AND DECAY OF APPLES

The object of this experiment was to determine the relationship of bruising to blue mold (Penicillium expansum) decay infections in apple fruits, with attended consideration of the size of the fruits and the severity of the bruising.

## MATERIALS AND METHODS

Two hundred fifty large and small fruits were carefully picked from one tree in each of 3 orchards. Picking dates, variety, and maturity are indicated in table 1. All lots of fruit were placed at 31°F. the day they were picked.

Starting with bruise-free apples it was necessary to have standardized, uniform bruises and a comparable exposure to blue mold spores. The latter, being accomplished by dipping the fruits in a water suspension of spores, will be referred to as being "inoculated".

The large and small apples from each orchard were later composited into six lots of each size-group for treatments as follows: (a) check, non-bruised, non-inoculated, (b) non-bruised, inoculated, (c) slight bruise, non-inoculated, (d) severe bruise, non-inoculated, (e) slight bruise, inoculated, and (f) severe bruise, inoculated. These treatments were carried out October 13 and 14 in the following manner.

Standardized bruises were made at room temperature by placing a piece of waxed cardboard on the platform of a scale, against which the cheek of a fruit was pressed until the beam tripped under a 40 lb. weight for the

slight bruise and under a 75 lb. weight for a severe bruise. Two bruises of one intensity were made on each fruit, using opposite cheeks. When an entire lot had been bruised, the circumferances of 10 randomized fruits were measured and size variations computed (table 2). The diameter of each bruise was measured in 2 directions at right angles. At this time average firmness of the apples, as given in table 3 with bruise diameters, were determined, using a 7/16 inch pressure tester plunger on 3 pared surfaces of 10 fruits of each orchard size-group.

The lots to be inoculated were immersed for 10 seconds in a fresh suspension of blue mold spores from five 10-day old Petri plate cultures in 13 liters of tap water. The spores were well separated and wetted by means of a Waring blender.

All lots remained at room temperature until the day following treatment when they were again stored at 31°F. until examined for decay infections on December 29.

## RESULTS

Bruising Damage: In the lots of large-sized fruits, apples from orchard 3 ran to larger sizes (table 2), were less firm and the diameters of the severe bruises from 75 lbs. pressure averaged significantly greater than with apples from the other 2 orchards (table 3); but slight bruise diameters, from 40 lbs. pressure, cannot be correlated with sizes and condition.

Firmness in the lots of small sizes was in the order of orchard numbers 1, 2, and 3, the latter being the most firm. Data in table 3 show

that average bruise diameters were smaller the more firm the fruit.

Effect of Bruising on Subsequent Decay: The rots observed in December occurred where there were no apparent skin ruptures and had a similar appearance to invasions commonly spoken of as "lenticel decay".

Freedom from decay in apples not bruised or dipped in a water suspension of blue mold spores, the comparative freedom from decay in lots bruised but not inoculated and the frequency of decay invasions in the bruised areas when inoculated (table 4) show that bruises contributed heavily to apple rots when spore contamination was present. In the large fruits that were severely bruised and inoculated the average infection at bruises was 58 percent; in fruit from orchard number 3 this ran as high as 103 percent.

When apples were not dipped in the blue mold suspension not a single infection developed in any lot of fruit from the 3 orchards even though there were lots from each having the two degrees of bruising (table 4). In some instances non-bruised apples that were dipped in the blue mold suspension had decay infections. This emphasizes the hazard of contaminated washing solutions.

The averages of infections at bruises in inoculated apples (table 5) show (a) decay invasions were more numerous in the severe than in the slight bruises, and (b) infections were more numerous at bruises in the large-sized fruits than in those of small sizes. Fruit from orchard number 3 had an outstandingly larger percentage of infections at bruises than apples from

the other two orchards. The apples from orchard number [illegible] were larger in size and were more mature when picked. Apples from orchard number [illegible] were the least mature when picked and had the smallest percentage of infections at bruises.

## CONCLUSIONS

Bruising damage, judged by bruise diameter, was generally directly related to the size of the fruit though differences were not significant where severe bruising pressure was applied to the least mature fruit.

Bruises without skin ruptures, were responsible for heavy decay infections when apples were dipped in spore-contaminated water; more infections occurred at severe bruises than at slight bruises and more infections occurred in large than in small fruit. There was a greater difference in frequency of infection between large and small fruits than there was between severe and slight bruises.

Many apple rots, appearing as "lentical decay", are caused by bruised apples being subjected to mold spore infection such as would take place in contaminated washing solutions.

Table 1.

Variety and Harvesting Data

Wenatchee, Washington. 1947

| Orchard No. | Variety | Maturity | Picking Date |
|---|---|---|---|
| 1 | Starking | Optimum | September 13 |
| 2 | Delicious | Nearly Optimum | September 22 |
| 3 | Richared | Very Advanced | September 29 |

Table 2.

Percentage Distribution of Apples in Size Classes

| Orchard No. | | Commercial sizes representing numbers of fruits per packed box | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 40-56 | 64 | 72 | 80 | 88 | 100 | 113 | 125 | 138 | 150 | 163 |
| 1. | Large | 2.5 | 7.5 | 32.5 | 22.5 | 22.5 | 12.5 | 2.5 | | | | |
| | Small | | | | | | | 16.5 | 40.5 | 21.4 | 14.3 | 4.8 |
| 2. | Large | | 11.9 | 26.2 | 21.4 | 14.3 | 23.8 | | | | | |
| | Small | | | | | | 4.6 | 21.0 | 25.3 | 18.6 | 18.6 | 11.6 |
| 3. | Large | 32.5 | 20.0 | 22.5 | 2.5 | 5.0 | | | | | | |
| | Small | | | | | 2.2 | 6.5 | 26.0 | 23.9 | 19.6 | 19.3 | 2.2 |

Table 3.

Fruit Firmness and Bruise Diameters
Wenatchee, Wash. October 13-14, 1947.

| Orchard Number | Large Fruit |  |  | Small Fruit |  |  |
|---|---|---|---|---|---|---|
|  | Pressure Test[1] | Slight Bruise | Severe Bruise | Pressure Test[1] | Slight Bruise | Severe Bruise |
|  | Lbs. | Cm. | Cm. | Lbs. | Cm. | Cm. |
| 1 | 14.3±0.16[2] | 2.41±0.03[2] | [illegible]±0.03[2] | 17.0±0.13[2] | 2.37±0.04[2] | 3.12±[illegible][2] |
| 2 | 14.9±0.19 | 2.31±0.02 | 3.18±0.03 | [illegible].9±0.19 | 2.28±0.02 | 3.22±0.01 |
| 3 | 12.8±0.56 | 2.45±0.06 | 3.40±0.05 | [illegible].9±0.35 | 2.24±0.04 | [illegible].12±0.06 |

---

[1] Average of pressures taken on [illegible] pared surfaces of 10 fruits with 7/16" plunger at time of bruising.

[2] Standard error

Table 4.

Summary of Blue Mold Decay in Apples From Three Orchards

Wenatchee, Wash. December, 1947.

| FRUIT SIZE | TREATMENT | Number APPLES | NUMBER BRUISES | NUMBER DECAYED BRUISES | PERCENT BRUISES DECAYED | NUMBER INFECTIONS AT BRUISES | NUMBER INFECTIONS NOT AT BRUISES |
|---|---|---|---|---|---|---|---|
| Large | Not br., not inoc.[1] | 83 | 0 | 0 | 0 | 0 | 0 |
| | Not br., inoc. | 85 | 0 | 0 | 0 | 0 | 9 |
| | Sl. br., not inoc. | 98 | 196 | 0 | 0 | 0 | 0 |
| | Svr. br., not inoc. | 103 | 206 | 1 | 0.5 | 1 | 0 |
| | Sl. br., inoc. | 99 | 198 | 34 | 17.2 | 45 | 11 |
| | Svr. br., inoc. | 94 | 188 | 83 | 44.2 | 109 | 4 |
| Small | Not br., not inoc. | 123 | 0 | 0 | 0 | 0 | 0 |
| | not br., inoc. | 102 | 0 | 0 | 0 | 0 | 2 |
| | Sl. br., not inoc. | 105 | 210 | 0 | 0 | 0 | 0 |
| | Svr. br., not inoc. | 125 | 250 | 0 | 0 | 0 | 0 |
| | Sl. br., inoc. | 130 | 260 | 8 | 3.1 | 9 | 1 |
| | Svr. br., inoc. | 106 | 212 | 25 | 11.8 | 26 | 2 |

[1] Abbreviations: br. - bruise; inoc. - inoculated; sl. - slight; svr.-severe.

Table 5.

Summary of Infection Percenteges in Inoculated Lots
Wenatchee, Wash. December, 1947.

| | At Severe Bruises | | | At Slight Bruises | | | In Large Fruits | | | In Small Fruits | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Orchard No. | No. Bruises | No. Infect. | Percent Infect. | No. Bruises | No. Infect. | Percent Infect. | No. Bruises | No. Infect. | Percent Infect. | No. Bruises | No. Infect. | Percent Infect. |
| 1. | 114 | 37 | 32.5 | 120 | 14 | 11.7 | 124 | 40 | 32.2 | 110 | 11 | 10.0 |
| 2. | 140 | 13 | 9.3 | 168 | 7 | 4.4 | 122 | 18 | 14.7 | 176 | 2 | 1.1 |
| 3. | 146 | 87 | 59.6 | 180 | 34 | 18.9 | 140 | 97 | 69.3 | 186 | 24 | 12.9 |
| Average | | | 34.2 | | | 12.0 | | | 40.0 | | | 7.8 |